Federal Aviation Administration
APNT Industry Day
Concept of Operations Overview

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Overview

- Background – APNT Research
- The role of *Communication, Navigation, and Surveillance* (C-N-S)
- Specific Problem - Radio Frequency Interference
- Four Pillars of APNT
- Current Ground Aid and User Equipment Capabilities
- NextGen Operational Concepts: Destination 2025
- Shortfalls
- Technological Opportunities
- Operational Scenario Examples

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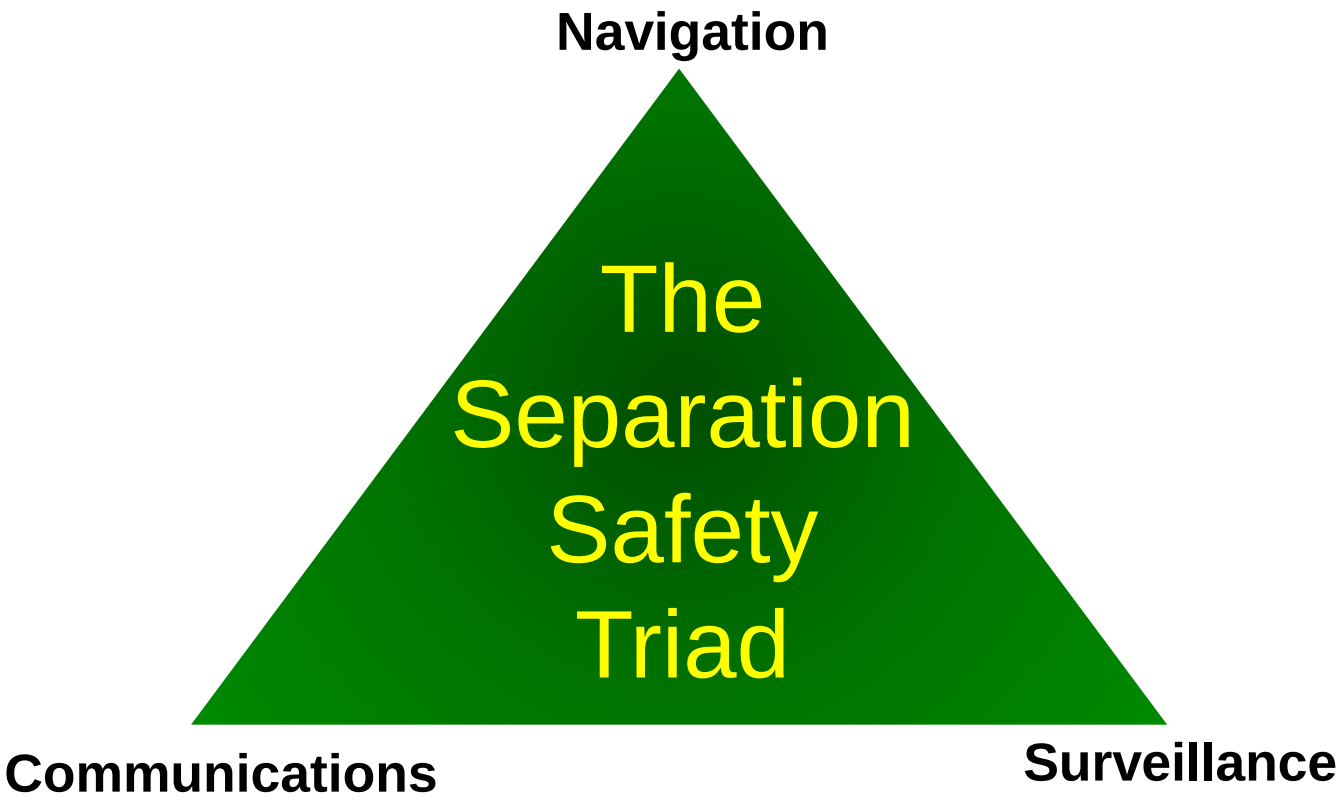
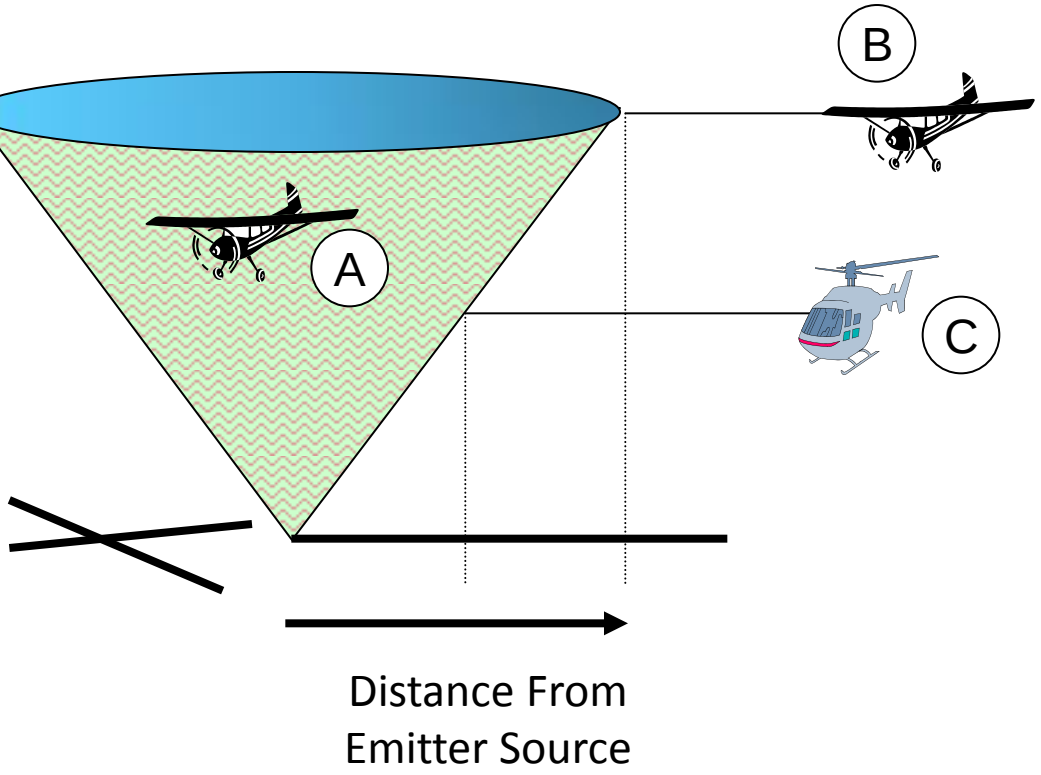
Traditional Role of C-N-S

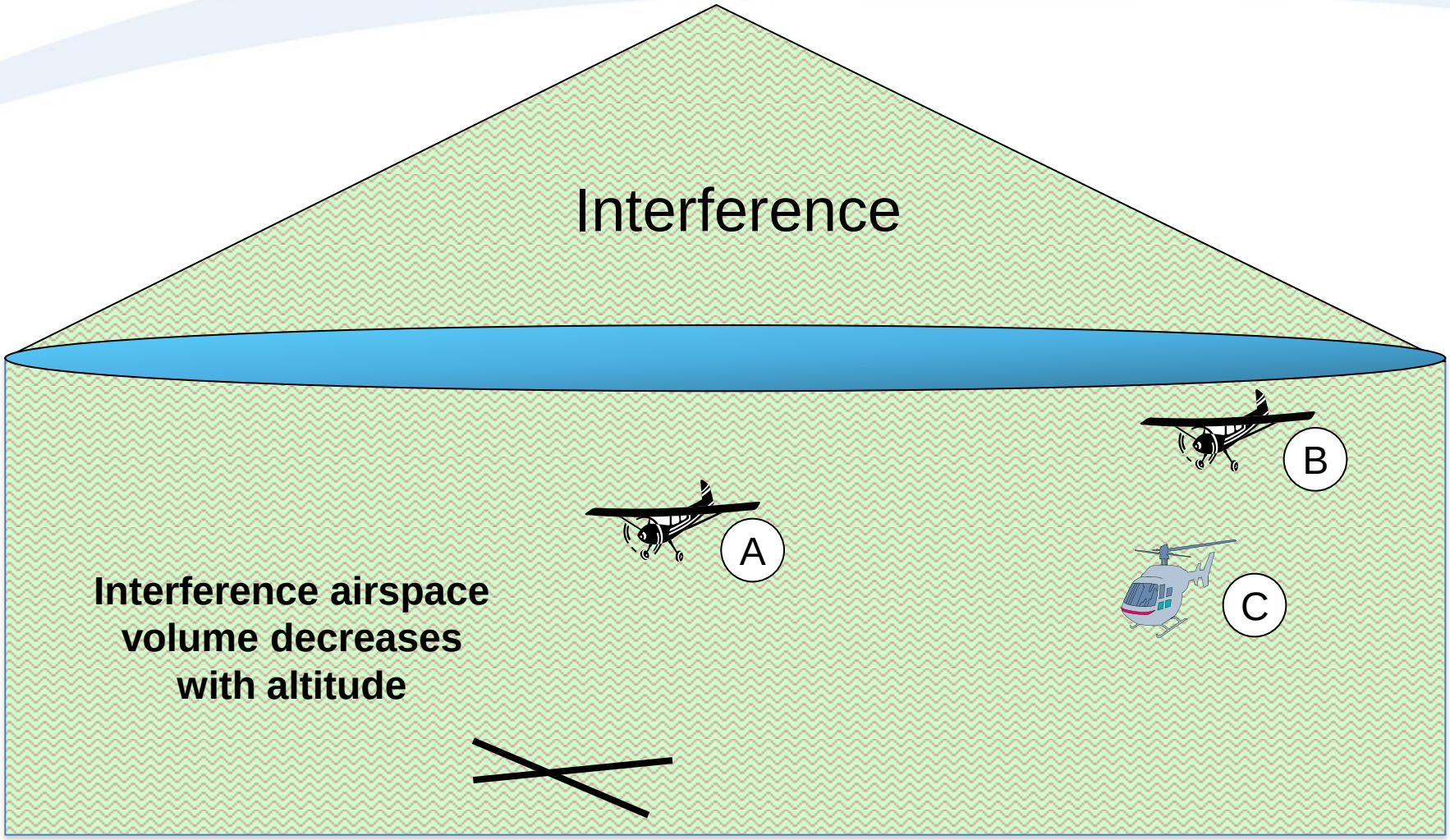


Interference is Line-of-Sight

Interference airspace volume increases with altitude



Airborne Emitter Swallows All in Sight



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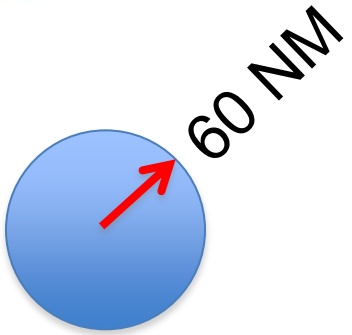
Interference Scenarios

Terminal



Unintentional Interference
Nefarious Actor
Ground or Mobile
Fixed or Intermittent

En Route

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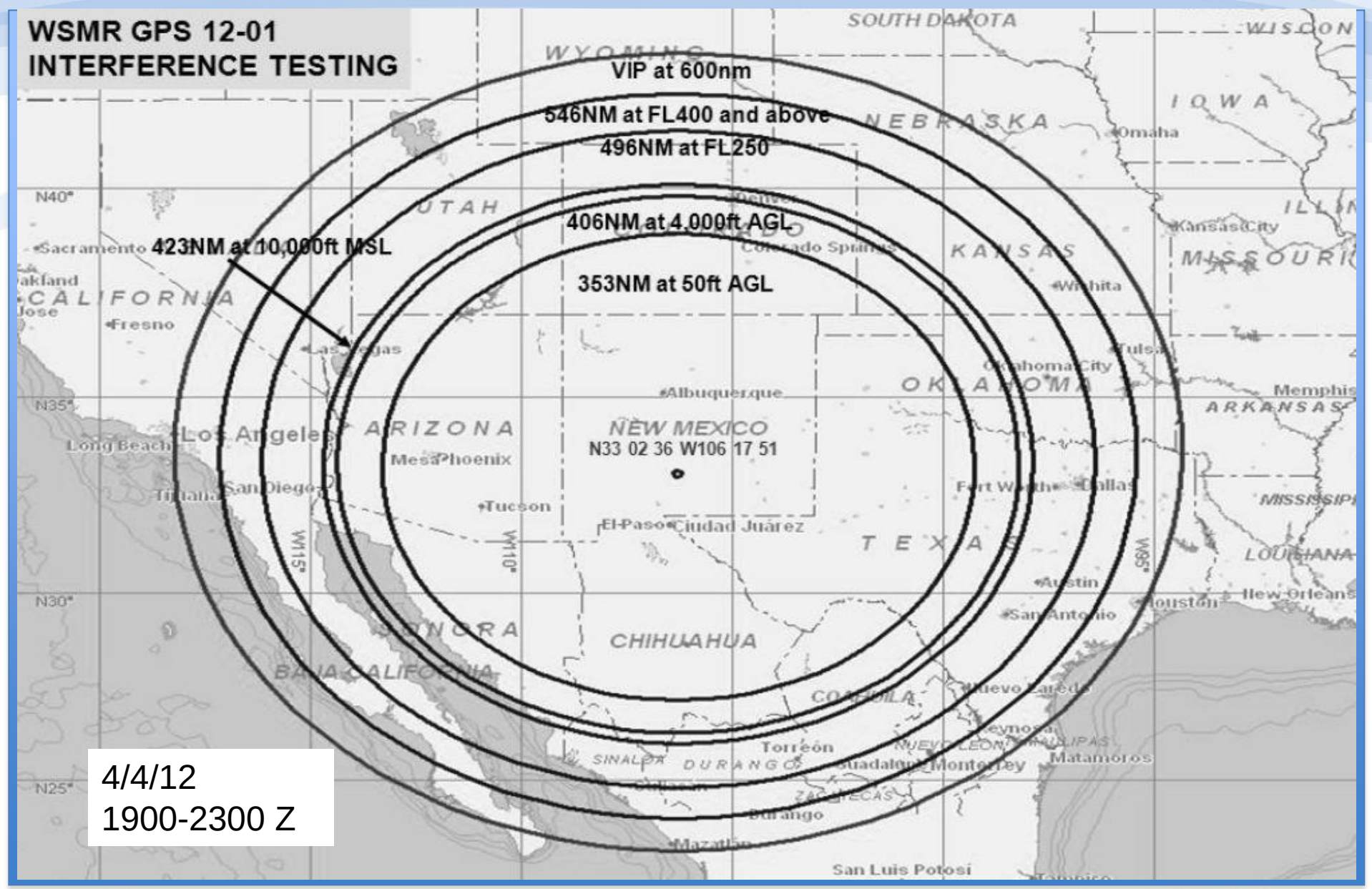
WSMR GPS 12-01
INTERFERENCE TESTING
VIP at 600nm
546NM at FL400 and above
496NM at FL250
406NM at 4,000ft AGL
423NM at 10,000ft MSL
353NM at 50ft AGL
N33 02 36 W106 17 51
4/4/12
1900-2300 Z

Today's Navigation Aids

- Flight plans are formed using:
  - Waypoints
  - VORs, Victor and Jet Airways
  - RNAV/RNP, Q (high) and T (low) Routes
- Users navigate by:
  - Flying the routes defined by VORs and Airways or RNAV Routes

En-route	Terminal	Approach
VOR	**VOR**	**VOR**
RNAV DME/DME/IRU GPS/WAAS (RNP)	**RNAV** DME/DME/IRU GPS/WAAS(RNP) **NDB**	**RNAV** GPS/WAAS(RNP) **NDB** **ILS**
Legacy APNT (GPS users revert back to VOR, DME/DME/IRU and ILS)		

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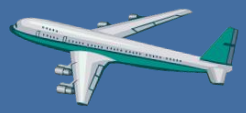
Current Users and Possible Equipage

Major/ Large Aircraft Air Carriers	Regional Air Carriers	Corporate Aircraft	General Aviation Equipped with Modern Avionics	Older General Aviation
				
GPS/WAAS with IRU	GPS/WAAS without IRU	GPS/WAAS with & without IRU	GPS/WAAS	
DME/DME/IRU	DME/DME	DME/DME		DME
VOR	VOR	VOR	VOR	VOR
NDB	NDB	NDB		NDB
ILS	ILS	ILS	ILS	ILS

Technological Opportunities

- What can be done now with existing aircraft avionics?
  - VOR Minimum Operational Network
  - Retention of ILS
  - Leveraging improved DME/DME coverage
- Longer-term solutions require research
  - Multilateration, where the ground provides the aircraft its position
  - Pseudolites, where a robust infrastructure supports the equivalent of GPS, but from the ground

NextGen APNT CONOPS Pillars

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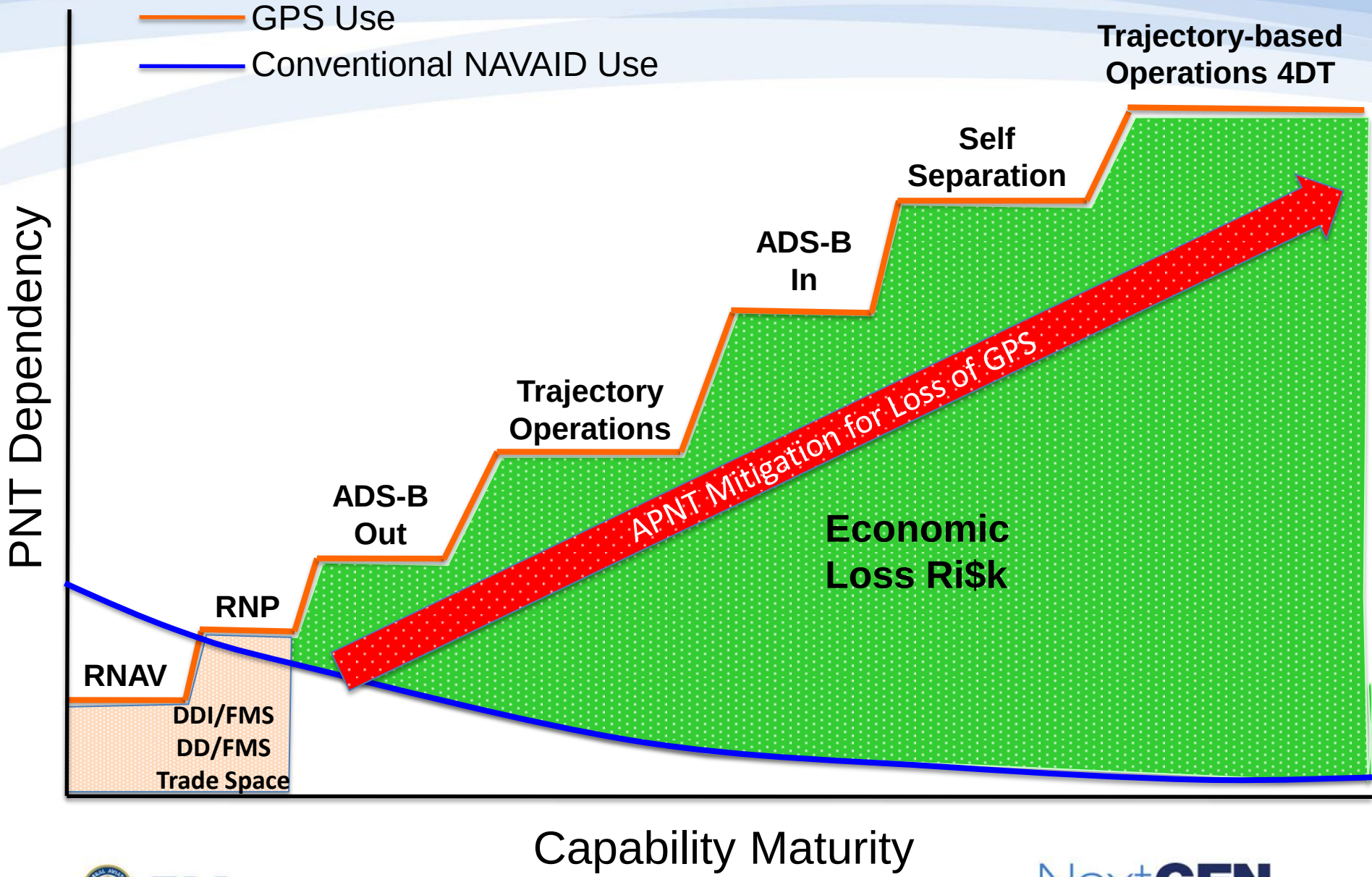
GPS Use
Conventional NAVAID Use
Trajectory-based Operations 4DT
Self Separation
ADS-B In
Trajectory Operations
ADS-B Out
RNP
RNAV
DDI/FMS
DD/FMS
Trade Space
APNT Mitigation for Loss of GPS
Economic Loss Ri$k
PNT Dependency
Capability Maturity

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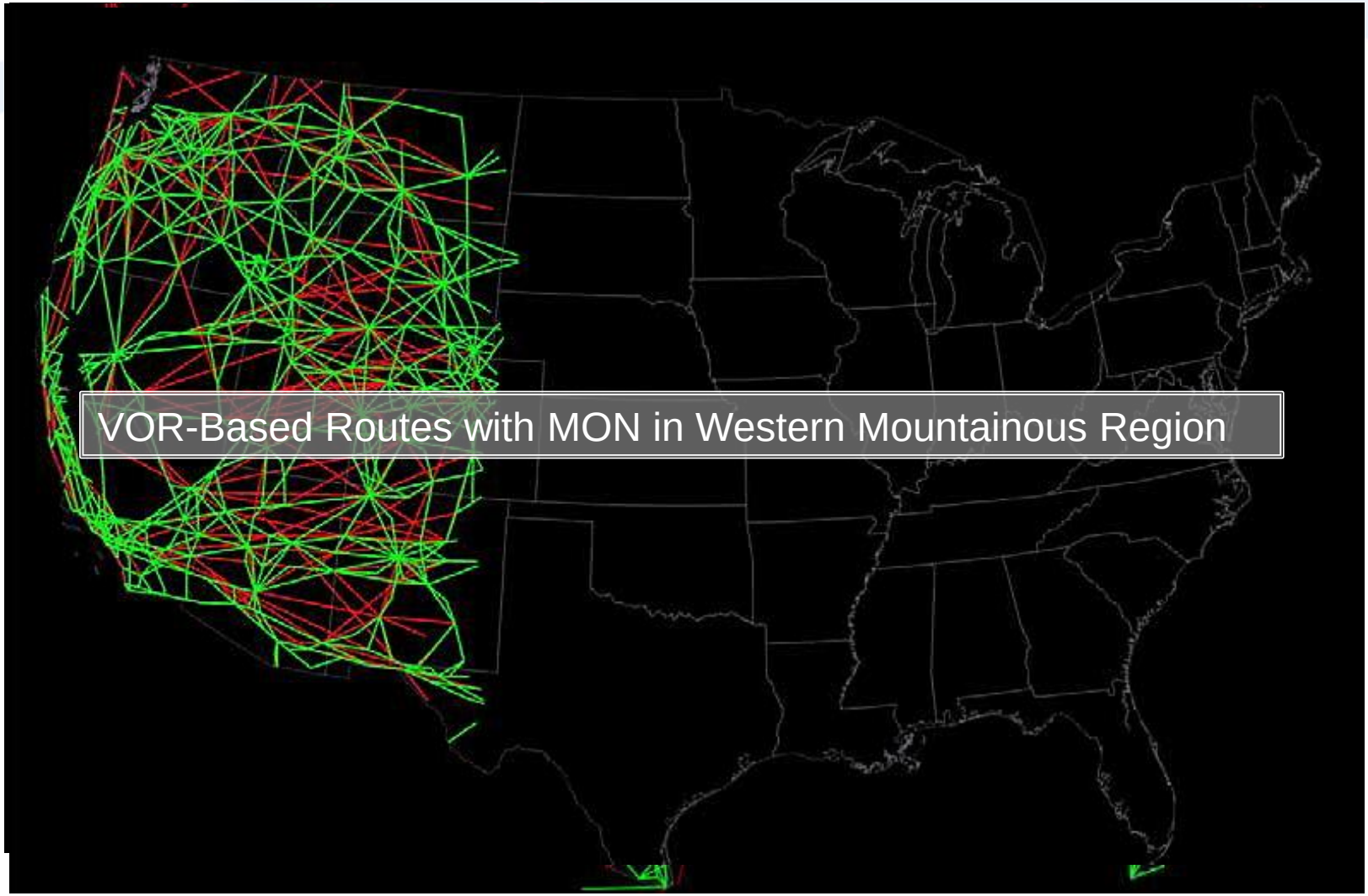
VOR-Based Airways and Routes



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NextGen Transformation

- Surveillance is transitioning primary position source from Secondary Surveillance Radar (SSR) to Automatic Dependent Surveillance Broadcast (ADS-B)
- SSR, WAM will be used as a backup to ADS-B
- ADS-B position currently only provided by GPS or WAAS
- Future separation standards to meet NextGen capacities (3 mile en route separation)

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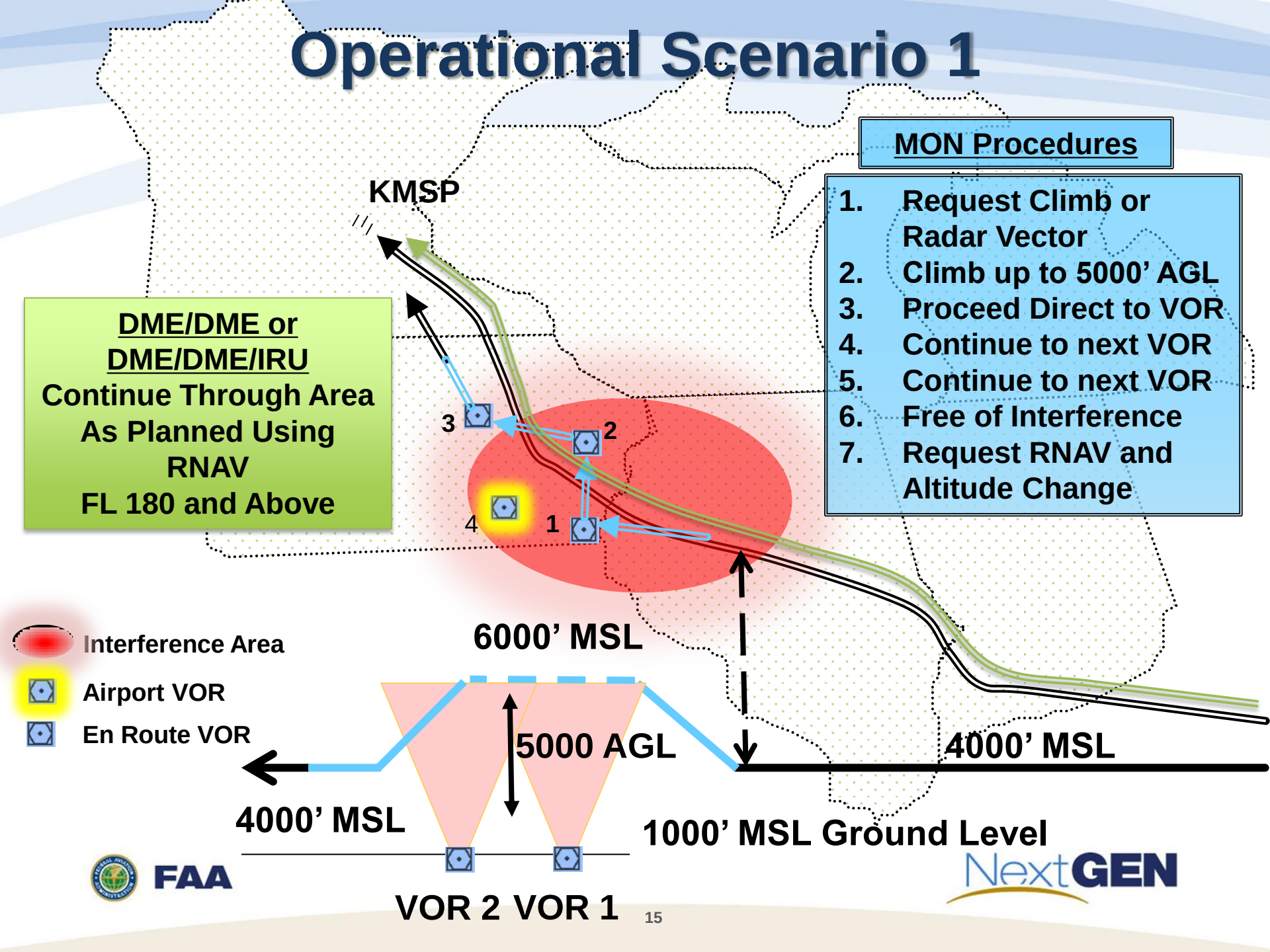
Operational Scenario 1

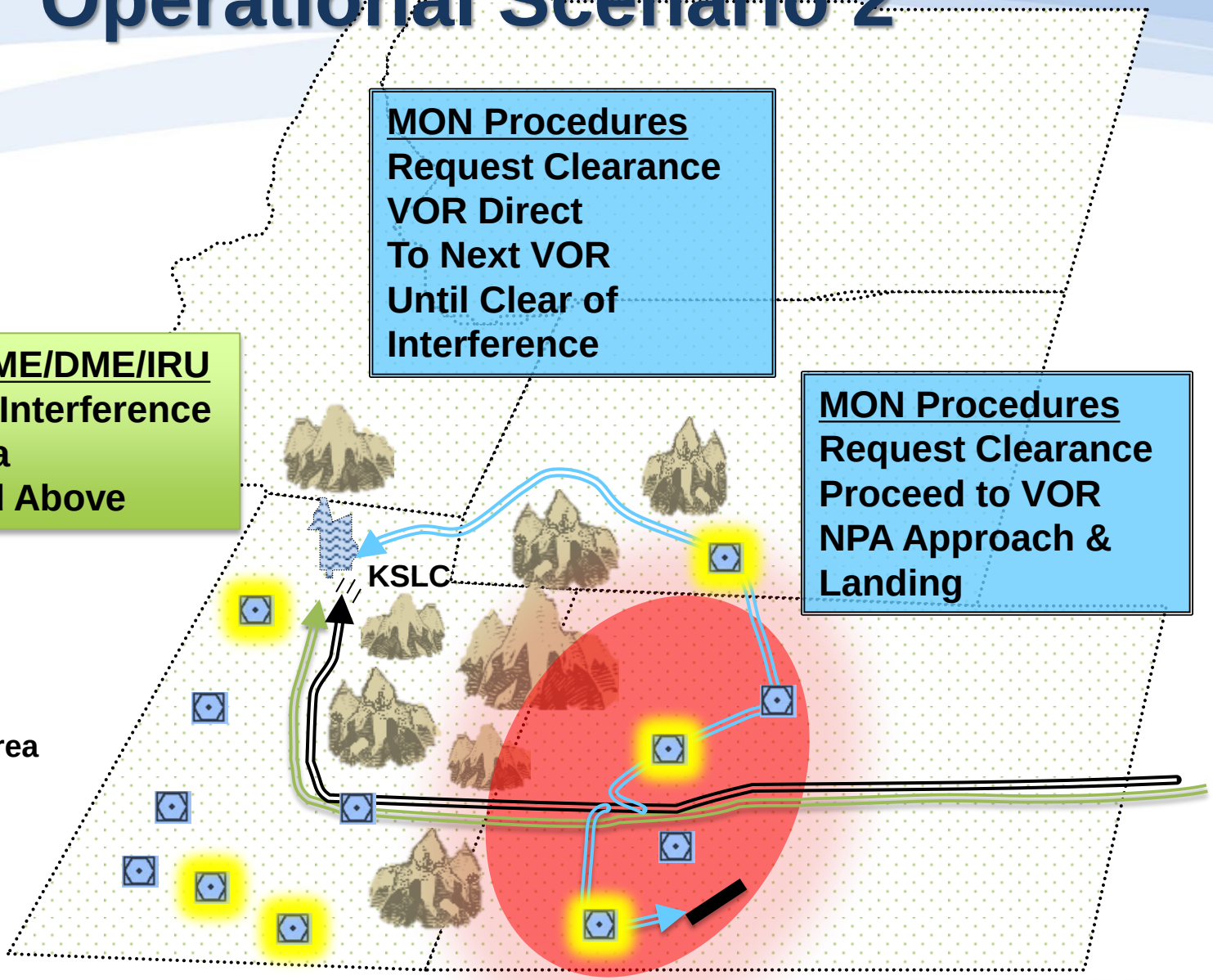


Operational Scenario 2

MON Procedures
Request Clearance
VOR Direct
To Next VOR
Until Clear of
Interference

DME/DME or DME/DME/IRU
RNAV Through Interference Area
FL 240 and Above

MON Procedures
Request Clearance
Proceed to VOR
NPA Approach &
Landing



Interference Area
Airport VOR
En Route VOR

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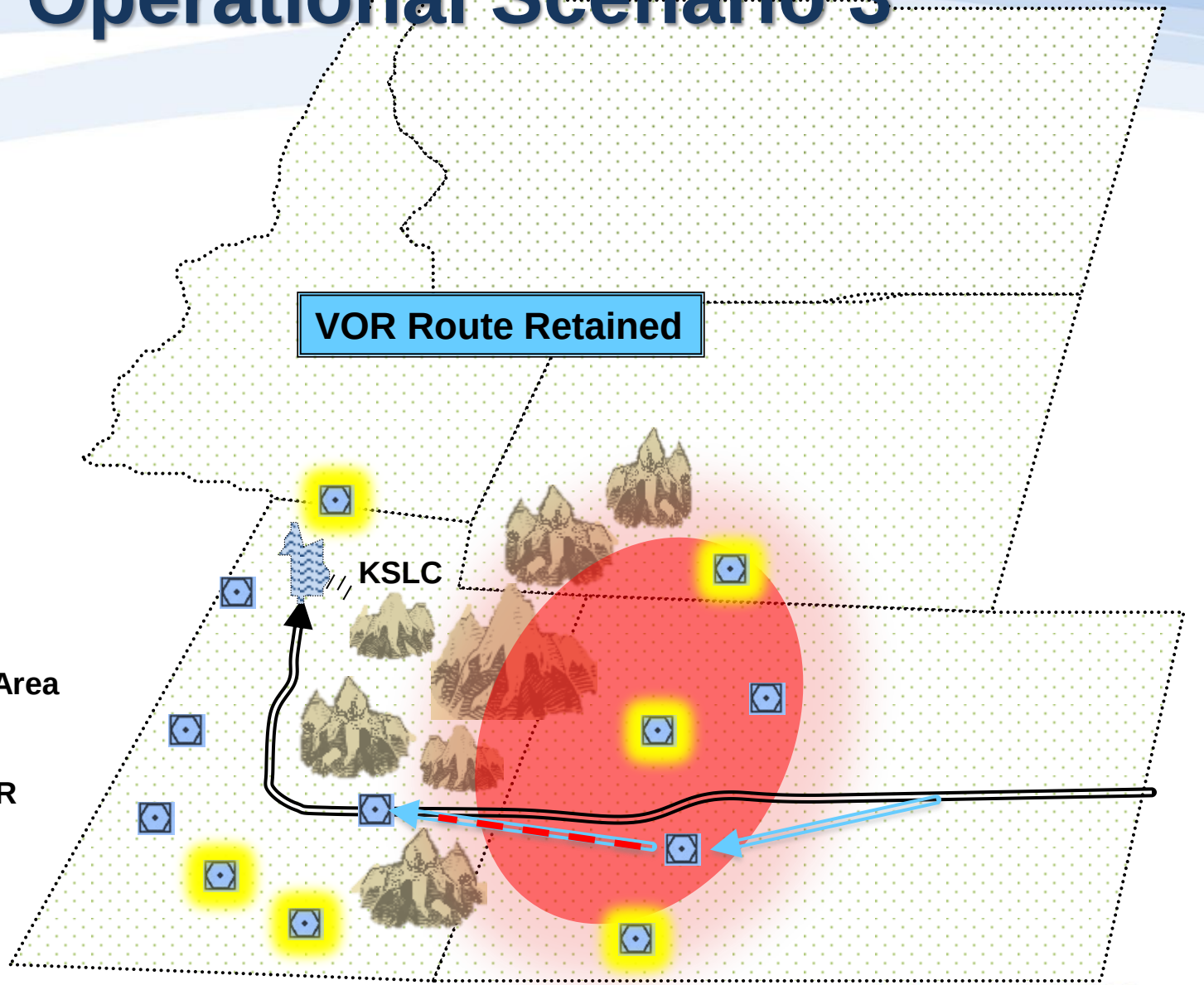
Operational Scenario 3



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Summary

- **Federal Aviation Administration: GNSS Library Documents Weblink**

http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/library/documents/media/20120319_APNT_CONOPS_FINAL.pdf

- **Technical Papers will be published for ION JNC and GNSS in 2012**

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Opportunity for Feedback

- Opportunity for Input and Feedback on NextGen APNT Concept of Operation
- APNT Industry Day Questions & Answers Session beginning at 1:00PM
  - Please use index cards for questions submitted to the APNT Team
  - Please request a microphone for in-person questions to the APNT Team

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